



5. Report of the Subcommittee on Instructional Materials

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CONTENTS

- I. Accuracy of Textbooks
- II. Length, Coherence, and Sequencing of Topics
- III. The What Works Clearinghouse
- IV. Research Recommendations

List of Abbreviations

WWC What Works Clearinghouse

I. Accuracy of Textbooks

It might be assumed that textbooks for middle school and high school math would be free of errors. When mathematicians have reviewed already published middle and high school textbooks, however, they have identified a non-trivial number of errors, and a large number of ambiguous and confusing statements and problems. Many of these errors and ambiguities arise on word problems that are intended to elicit use of the mathematical concepts and procedures in real-world contexts. The Subcommittee recommends that publishers obtain reviews from mathematicians prior to publication, so that these errors and ambiguities can be identified and corrected. This is especially needed for first editions of textbooks, which tend to have the greatest numbers of errors and ambiguities. Having mathematicians also read textbooks in the formative stages may increase the coherence of the presentation of mathematics between earlier and later grades.

II. Length, Coherence, and Sequencing of Topics

U.S. mathematics textbooks are extremely long. Not counting study guides and answers at the end of the books, middle and high school textbooks typically range from 600 to more than 900 pages. The study guides and answers sometimes exceed 1,000 pages. Even elementary school textbooks sometimes exceed 700 pages. The length of math textbooks was much shorter in previous decades and continues to be much shorter in many nations with higher mathematics achievement than the United States. Thus, the great length is not needed for effective instruction.

Textbook publishers emphasize that a major source of the textbooks' length is the need to cover all of the benchmarks encompassed in any state's standards. A topic covered in sixth grade in one state may be covered in seventh grade in another state and in eighth grade in a third state; this leads to the topic being included in all three grades' math textbooks. The large influence of this factor is illustrated by the fact that the state-specific editions of Algebra I textbooks published for California, Texas, and Florida are roughly 25% (more than 200 pages) shorter than the national edition published for the other 47 states. Coverage of all of the states' benchmarks for a given grade is likely to increase length and decrease coherence—this is despite the fact that mathematics is especially amenable to a coherent treatment. Integrating new concepts with previous ones is impossible when textbook writers cannot anticipate which topics students already have encountered. The Subcommittee recommends that states and districts strive for greater agreement regarding which topics will be covered in which grades and that textbook publishers publish editions that include only the material that these states and districts agree to teach in specific grades.

Another indicator and source of lack of coherence of some textbooks is the table of contents. Tables of contents should provide students, teachers, and textbook adoption teams with a sense of the organization of the mathematical topics in the book. In some textbooks, however, tables of contents emphasize not the mathematics but rather specific applications (e.g., Ferris Wheels, Penny Jars). Tables of contents that emphasize the mathematical content seem more likely to help students appreciate the coherence inherent in mathematics.

Other potentially useful ways of decreasing length and increasing coherence are 1) reducing the number of photographs that are not essential to the mathematical content; 2) placing content aimed at providing extra review, enrichment, or motivation in supplements rather than in the main textbook; and 3) excluding applications in which the primary challenge is posed by the social studies or science content.

III. The What Works Clearinghouse

The What Works Clearinghouse (WWC) identifies and evaluates studies of the effectiveness of educational interventions (i.e., programs, products, practices, and policies). Using published studies and additional information such as technical reports, WWC summarizes the strength of evidence about each intervention in terms of established standards. Among these standards is the timeframe, design, sample, intervention, outcome, and statistical reporting. Based on the evidence, products are characterized in terms of their effects on student achievement (i.e., positive, potentially positive, negative, potentially negative, mixed, or no discernable effect). The WWC also provides information on the extent of evidence, and provides a registry of outcome evaluators (individuals or organizations) who conduct research on the effects of educational interventions. The goal of this registry is to help schools, school districts, and educational program developers.

Although many aspects of studies are well characterized within WWC, other aspects are less well specified. The WWC does not evaluate the content of the curriculum, so formal assessments of the length, coherence, and correctness of items within the curricula are not available. In addition, information about methods used to train teachers is often limited or unavailable. This lack of information about teacher training no doubt reflects the level of description within the supporting studies; without such information, however, understanding reasons for the effects or lack of effects of interventions is difficult.

The Subcommittee therefore recommends that WWC report information on 1) curriculum content (including variables related to coherence, length and accuracy) and 2) teacher training and professional development. Such information would help teachers and school districts use the instructional materials. Although this information may not be available from existing studies, requiring it from programs that are evaluated in the future may create a data source that can be used to establish best practices from the perspective of the teacher.

IV. Research Recommendations

A large amount of research has been conducted on instructional materials, but most of it does not meet even moderately stringent methodological criteria. These methodological deficiencies limit the usefulness of the studies in guiding educational decisions. The Subcommittee recommends that governmental funding agencies give priority to research that meets stringent methodological criteria, especially randomized controlled designs in which students, classrooms, or schools are randomly assigned to conditions and studied under carefully controlled circumstances. Studies that include large enough samples of students, classrooms, teachers, and schools to identify effects that are present should also be given priority. Such studies are considerably more expensive than studies with small samples, but they provide a much sounder basis for educational policy.